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POWER SUPPLIES UNLIMITED

CR-18-30-B

NJE CORPORATION Kenilworth, New Jersey

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INSTRUCTION MANUAL

FOR

CR-LINE CR-18-30-B

TRANSISTORIZED REGULATED

POWER SUPPLY

CR-18-30
CR-36-20
CR-36-6

NJE CORPORATION
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Kenilworth, N. J.
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SECTION I

SPECIFICATIONS AND DESCRIPTIONS

1-1. SPECIFICATIONS

Input:

Model	Volts	Line Current	Power Factor
CR-18-30	115 ± 10% 60 CPS ± 5%	10A	0.7
CR-36-20	115 ±10% 60 CPS ± 5%	15A	0.7
CR-36-6	115 ±10% 60 CPS ± 5%	6A	0.7

Output: Continuously adjustable by a front panel tenturn potentiometer.

Model	Volts	Amperes	Resolution
CR-18-30	0-18	0-30	3mv
CR-36-20	0-36	0-20	5mv
CR-36-6	0-36	0-6	5mv

Polarity: The output can be floated up to 500 volts peak above or below ground. Either polarity may be grounded to chassis.

Ripple: Total hum and noise will not exeed 1 millivolts rms.

Load Regulation:

Model	Static Load Regulation, No Load to full load.
CR-15-30	±0.01% or 1.0 MV*
CR-36-20	±0.01% or 1.0 MV*
CR-36-6	±0.005% or 0.5 MV*

*whichever is greater

Line Regulation: ±0.02% or ±1.0MV, whichever is greater, for slow or step line changes of ±10%, at a constant load.

Recovery Time: Less than 50 microseconds for a full load step.

Duty: Rated for continuous duty at ambient temperatures from 0° C to 50° C. Current rating must be reduced linearly to 0 at 85° C.

Termination:	A barrier type terminal strip at the rear of the unit provides terminals for input, output, remote sensing, remote programming, dualling, and ground.
Series Parallel (Dualling) Operation:	Two or more units may be operated in series to provide higher voltages at rated current, or in parallel to provide higher currents at rated voltage.
Circuitry:	Completely solid state. Silicon power rectifiers, silicon zener diode reference, germanium control and power transistors, all well-derated, characterize the quality and dependability of this supply.
Special Notes:	Model CR-36-6 is convection-cooled, high efficiency heatsink eliminates the need for blowers. Models CR-18-30 and CR-36-20 are air-cooled, by means of internal blowers. Do not block air flow.
Stability:	±0.05% or 2MV for 24-hour day at laboratory conditions
Protection:	Load and power supply protection for momentary overload or short circuit conditions is accomplished by an electronic current limiting circuit.
	If the fault condition is sustained, automatic removal of the load is effected by the thermal characteristics of a slow-blow type fuse.
Remote Sensing:	Sensing terminals, separate from the output terminals, are provided in order that the unit may "sense", and regulate against, the voltage at the load rather than the voltage at the output terminals.
Remote Programming:	This circuit has a sensitivity of about 140 ohms per volt. "Remote Program" terminals are provided. By varying the remote resistance in series with these two terminals, the output voltage may be accurately controlled from zero to rated voltage.

Meters: Two rectangular 2% meters are furnished installed on the front panel.

Model	Ammeter Range	Voltmeter Range	Meter Size
CR-18-30	0-30	0-20	3 1/2
CR-36-20	0-20	0-40	3 1/2
CR-36-6	0-10	0-50	2 1/2

Physical Data:

Model	D	W	H	Net Weight	Shipping Weight
CR-18-30	16 5/8"	19"	7"	70 lb.	80 lb.
CR-36-20	16 5/8"	19"	7"	70 lb.	80 lb.
CR-36-6	16 5/8"	19"	3 1/2"	40 lb.	45 lb.

Mounting: Suitable for laboratory bench use, or for 19" rack mounting.

Finish: Panel finish is two-tone gray enamel.

Panel Elements:
"On-Off" switch
AC line fuse in extractor post
"On" pilot light (red)
Output voltage control knob
Output voltmeter
Output ammeter

Environmental Conditions: This power supply will operate satisfactorily over the entire temperature range from +50° F to +120° F, with humidity up to 90% at altitudes up to 10,000 feet, without derating.

1-2. The power supply chassis assembly has an over-all width of 17 inches, and is mounted on a standard 19-inch relay rack panel. Components are mounted on sub-chassis which are secured between two side frames. This construction permits a free flow of air among the components, to facilitate dissipation of heat by the internal forced air-cooling and/or by convection radiation.

1-3. The unit is designed for installation in a standard relay rack or cabinet as well as for use as a bench instrument. It is equipped with a perforated metal cover which serves to protect both equipment and user during operation. All input, output, and control connections are available on a barrier-type terminal strip at the rear of the unit; and include two chassis ground connections, and the following terminals:

1-3. (continued)

1. AC input
2. AC input
3. Remote control
4. Remote control
5. Dualling
6. Dualling
7. Positive sensing
8. Positive output
9. Positive capacitor
10. Negative capacitor
11. Negative output
12. Negative sensing

1-4. The front panel elements consist of rectangular output voltmeter and ammeter of 2% accuracy, and AC on-off switch, output voltage adjust, a red pilot lamp to indicate application of AC input power, and AC input fuse. The DC output circuit fuse (where provided) is mounted on the rear of the chassis alongside the terminal strip.

SECTION II

INSTALLATION AND OPERATION

2-1. UNPACKING. The power supply is shipped in a cardboard carton which is floated on sufficient insulation in a heavy-duty shipping carton. Aside from normal precaution against damage to the unit in opening the cartons and removing the unit, no special procedures are required. The literature packed with the supply should be removed and held for reference in operating the equipment.

2-2. INSTALLATION. The supply can be mounted in any convenient location for bench use, and requires no adjustment or modification for such application. If the unit is to be installed in a housing, it is recommended that the rack or cabinet used be equipped with angle brackets, shelves, or slides to receive the unit, rather than suspending the assembly by its front panel mounting screws. The panel is notched for standard rack mounting.

2-3. When the unit has been properly placed in position, or mounted in its rack and secured in place by the panel screws, make the following connections:

1. Using no. 14 AWG wire, connect either the positive (TB1-8) or negative (TB1-11) DC output terminals of the supply (depending upon desired output polarity) directly to the chassis ground terminal at the barrier strip on the rear of the chassis, and connect the ground terminal to the system ground. If it is necessary that the power supply circuit float above or below ground, the output terminal should be connected to the chassis ground terminal by a 0.1 microfarad, 600 W VDC capacitor in place of the direct connection. Use of this by-pass capacitor will improve the stability of the circuit in the ungrounded condition, and reduce the effect of external interference and hum.

2. Connect the positive and negative output terminals, TB1-8 and TB1-9, respectively, to the corresponding terminals of the external load, using no. 10 AWG wire.

3. Connect the positive sensing terminal TB1-7 to the positive terminal of the remote load, and the negative sensing terminal TB1-12 to the negative terminal of the remote load. A twisted pair of no. 20 AWG (or larger) wire should be used for these connections. If accurate regulation at the remote load is not essential, then the sensing leads may be connected directly at the power supply output terminals; i.e. jumper TB1-7 and TB1-8, and jumper TB1-11 and TB1-12.

i. e. jumper TB1-7 and TB1-8, and jumper TB1-11 and TB1-12.

4. Output Capacitor Connections. The power supply has been shipped from the factory with the POS CAP terminal TB1-9 jumpered to POS OUT terminal TB1-8 and with NEG CAP terminal TB1-10 jumpered to NEG OUT terminal TB1-11. This connection is satisfactory for most applications. However, if improved transient and dynamic characteristics are required, the POS CAP and NEG CAP terminals should be connected to the remote load on separate, heavy-duty leads. Further improvement can be effected by using an independent capacitor (available from the factory) mounted physically as close to the ultimate load as is practical. Consult the NJE Engineering Department on special transient problems.

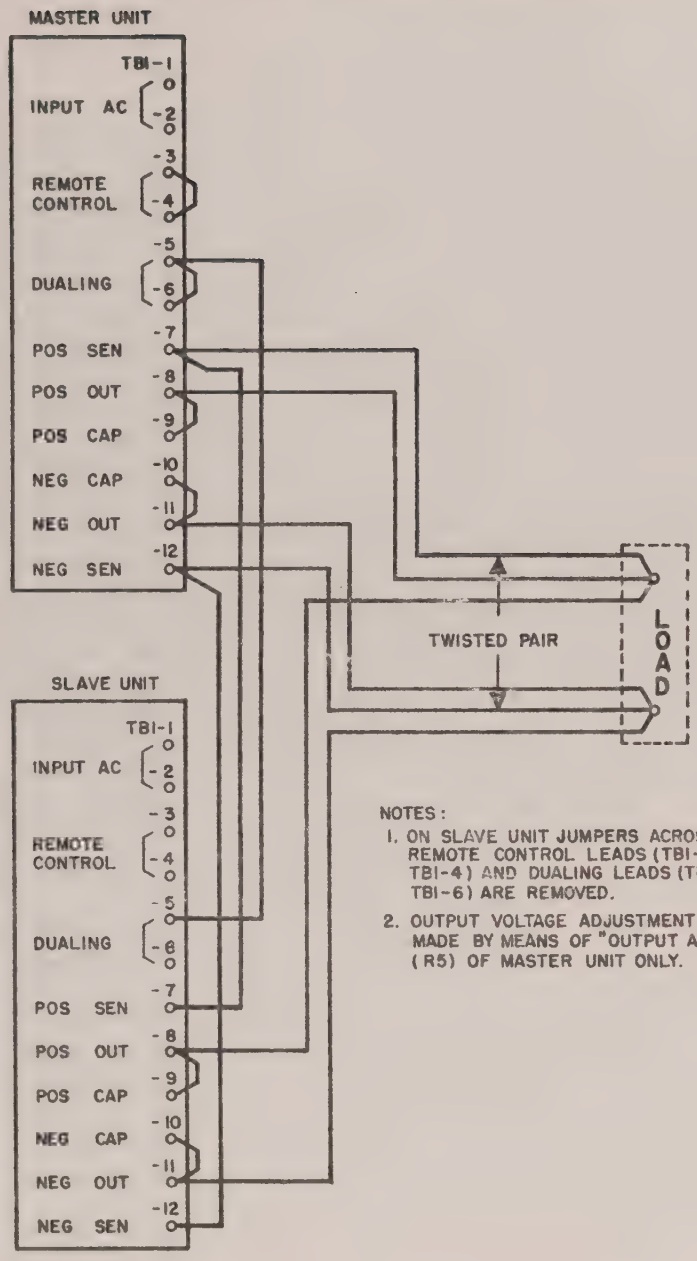
5. Remote Control - Programming. Terminals TB1-3 and TB1-4 are provided for the insertion in series of a remote control programming resistor. This circuit has a sensitivity of about 140 ohms per volt. When the panel voltage adjustment is set to zero, the output voltage may be accurately controlled from zero to rated voltage by varying the remote resistance.

6. Dualling. Two supplies may be operated in parallel (with an overall current derating of 10%), or in series. Consult the Dualling Schematic (Figure 1) for proper interconnection and wiring of the individual supplies and the load.

7. Connect the deactivated input line (115 volts nominal, 60 cycles, single phase) to the AC input terminals TB1-1 and TB1-2 on the barrier strip, using no. 12 AWG wire.

2-4. OPERATION. Set the AC control switch in OFF (open) position and energize the AC input line. Set the OUTPUT ADJUST control to full counterclockwise position, then place the AC control switch in the ON position. The indicator on the front panel should light. Observing the panel voltmeter, adjust the load voltage to the desired value, by means of the OUTPUT ADJUST. Check the load current meter to avoid overload conditions. If the required voltage value cannot be achieved, deenergize the input line and check connections on the rear terminal strip before referring to the troubleshooting section of this manual.

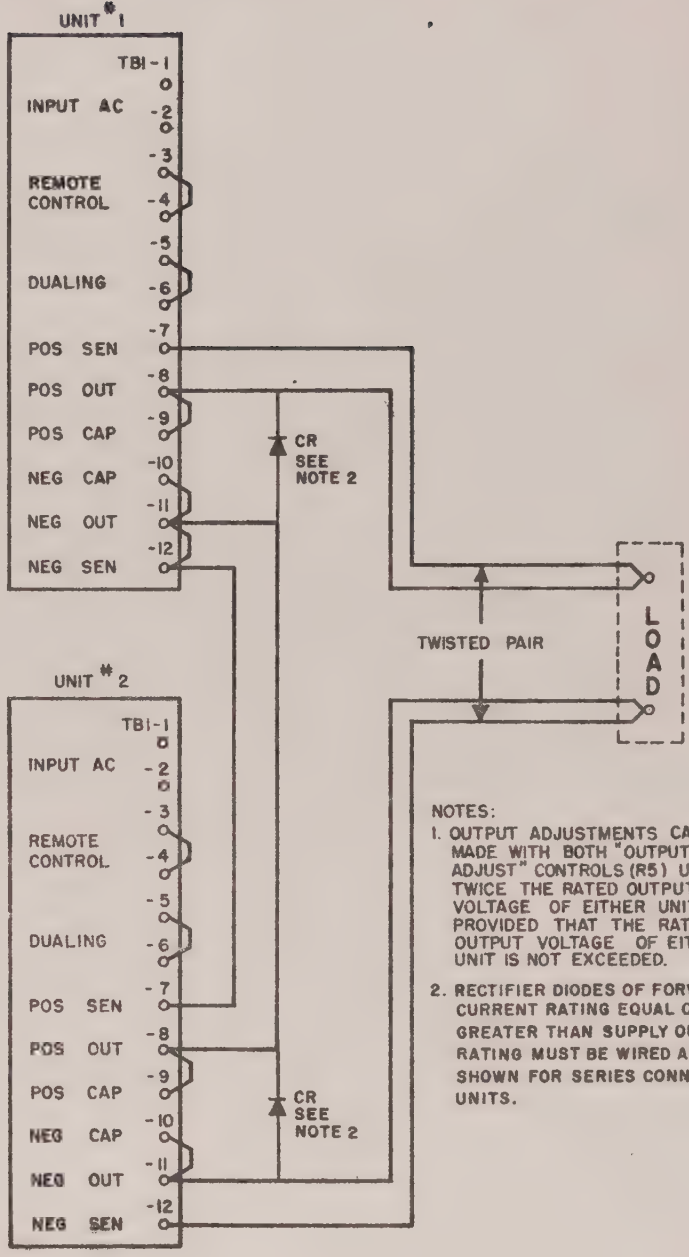
DUALLING SCHEMATIC
FIGURE 1



NOTES:

1. ON SLAVE UNIT JUMPERS ACROSS REMOTE CONTROL LEADS (TBI-3 & TBI-4) AND DUALING LEADS (TBI-5 & TBI-6) ARE REMOVED.
2. OUTPUT VOLTAGE ADJUSTMENT IS MADE BY MEANS OF "OUTPUT ADJUST" (R5) OF MASTER UNIT ONLY.

PARALLEL CONNECTION



NOTES:

1. OUTPUT ADJUSTMENTS CAN BE MADE WITH BOTH "OUTPUT ADJUST" CONTROLS (R5) UP TO TWICE THE RATED OUTPUT VOLTAGE OF EITHER UNIT PROVIDED THAT THE RATED OUTPUT VOLTAGE OF EITHER UNIT IS NOT EXCEEDED.
2. RECTIFIER DIODES OF FORWARD CURRENT RATING EQUAL OR GREATER THAN SUPPLY OUTPUT RATING MUST BE WIRED AS SHOWN FOR SERIES CONNECTED UNITS.

SERIES CONNECTION

SECTION III

PRINCIPLES OF OPERATION

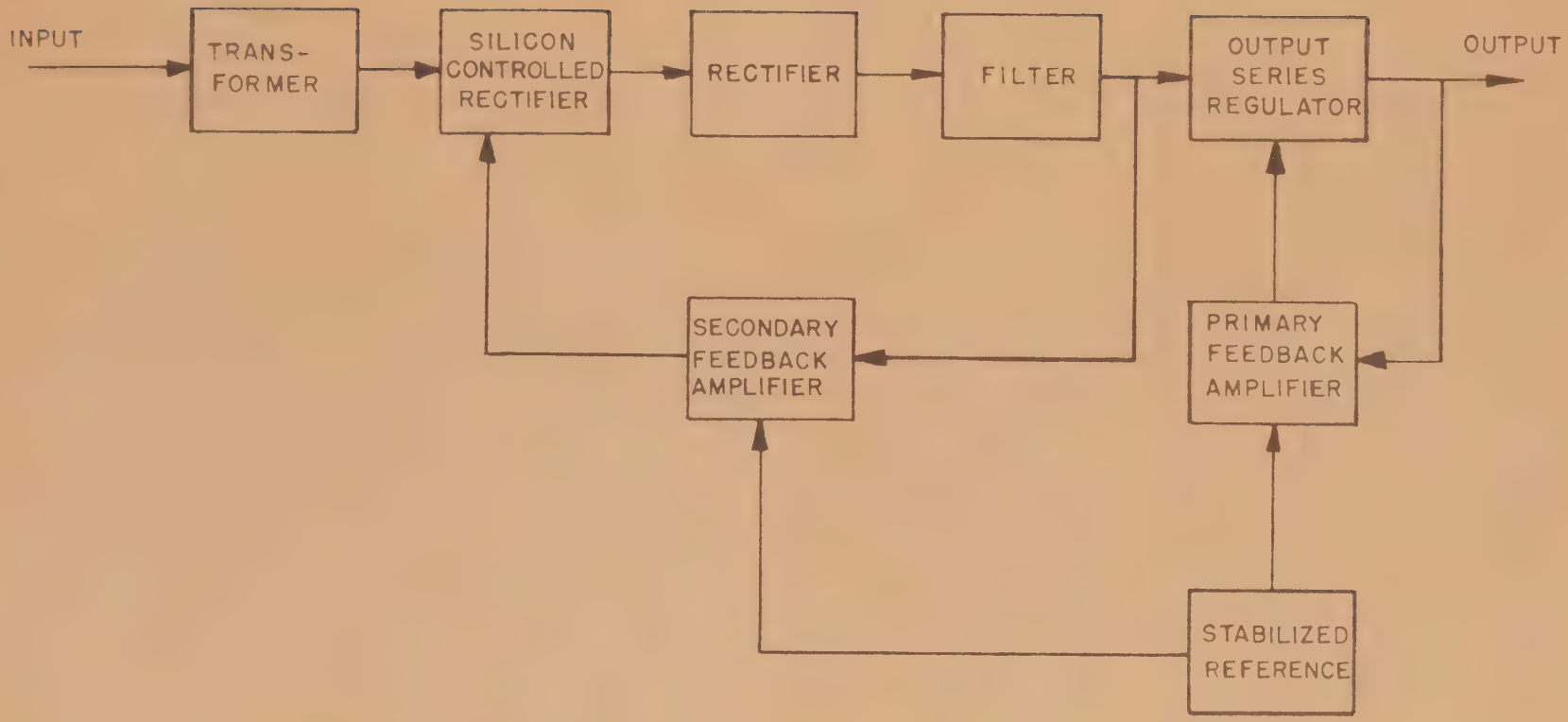
3-1. GENERAL. A simplified block diagram, illustrating the basic elements of the circuit and the signal flow, is shown in Figure 2. The AC line voltage is converted to a practical value by the power transformer and a full-wave diode rectifier. After passing through the controlled rectifier, a capacitor input filter smooths the pulsating DC output of the rectifier, providing a low-ripple, unregulated DC voltage to the output series regulator. The output voltage furnished to the load by the series regulator is monitored by a feedback amplifier which compares this voltage with a stabilized reference voltage and amplifies the difference between the two voltages. The output of the amplifier is used to control the regulator in such a way that it counteracts any change in the DC output voltage, thereby furnishing an essentially constant voltage to the external load. The controlled rectifier is basically a device which controls the magnitude of average DC voltage at the capacitor input filter in such a way as to maintain the storage voltage across the series regulator within its dissipation capability.

3-2. DETAILED CIRCUIT DESCRIPTION. Circuit references in the following material apply to the schematic diagram at the back of the manual. This diagram shows electrical relationships, without regard to actual physical location of the components, and is laid out in an arrangement approximately the same as that in the Block Diagram, Figure 2. Circled letter elements on the schematic refer to components which are not indicated by reference designations.

3-3. The power supply is energized by connecting 115 volts (nominal), 60 cycles, single-phase, to the input terminals, and closing switch (S1), attested by the lighting of pilot lamp (DS1).

3-4. The power transformer (T1) converts the 115VAC input line to an appropriate value on its secondary winding which is rectified by a full-wave rectifier (CR1 and CR2), providing a pulsating DC output which is passed through the controlled rectifier then smoothed by the capacitor input filter (C1) and applied through a regulating transistor assembly (A) to the external load. Capacitor (B) provides additional filtering of the output, and reduces the internal impedance of the supply for high-frequency load variations.

3-5. The output voltage on the auxiliary winding of transformer (T1) is rectified by diodes (CR-101 and CR-102) and (CR-103 and CR-104), and filtered by capacitor input filter (C102) - (C103) to provide positive and negative operating potentials for the feedback amplifier. Zener diode (CR109) in conjunction with its load resistor (C) provides regulated +18VDC, while diode (CR110) with resistor (D) provides -18 VDC (measured with respect to the neutral bus, of the amplifier). These zener diodes function in a manner analogous to that of a gaseous voltage regulator tube, providina a relatively constant output voltage across their terminals despite variations in the conducted current.



SIMPLIFIED BLOCK DIAGRAM

FIG. 2

Additional windings on T1 feed A2 the controlled rectifier power supply and driver circuit. The function of this circuit will be described later.

3-6. The feedback amplifier consists of three stages of amplification, the first two of which are balanced amplifiers, assuring minimum sensitivity to fluctuations in ambient temperature or operating voltages. The input signal for the amplifier is derived from a sensing voltage divider connected across the output of the supply. This divider consists of resistors (E) and (F) in the amplifier, and resistor (G) on the main chassis. The resistance setting of (G) determines the operating value of the DC output voltage of the supply in a manner which will be explained below. Resistor (G) is the output voltage control knob on the front panel. F101 at the base of Q108 provides protection for both the precision feedback resistor (G) as well as the transistor during surges arising because of transient load conditions.

3-7. The negative end of the sensing voltage divider (negative end of resistor (E) is returned to the negative output of the supply through zener diode (CR111) and the negative sensing lead. The diode, in conjunction with its load resistor (H) provides a highly stable potential of 6VDC for use as a comparison voltage by the input stage (Q107, Q108) of the feedback amplifier. When the output of the power supply (measured at the load) is precisely at its selected nominal value, the voltage at the base of transistor (Q108) (derived from the sensing voltage divider) is at the same level as the base of transistor (Q107), and the input stage is in balance. Under this condition, any tendency of the load voltage to vary in either direction will unbalance the amplifier, resulting in corrective action which compensates for the impending change, and holds the load voltage at its established value, as explained below.

3-8. Transistors (Q107) and (Q108) are PNP type units, operated in common-emitter mode, and connected as a balanced differential amplifier. Their outputs, taken across load resistors (I) and (J) are direct-coupled to the bases of the succeeding differential amplifier stage(Q105)-(Q106), which consists of two NPN transistors operated in common-emitter mode. The output of (Q105), from its load resistor (K), drives the base of the single-ended output stage (Q104). The output of the amplifier is tied directly to the base of the driver transistor (Q101).

3-9. Regulation of the DC output is performed by a double regulating system. A transistor series regulator consisting of power transistor (A) operating in parallel provides high-speed regulating action to correct for ripple and transient variations both at its input (C1) and at the output of the supply. The amplifier loop which provides correction signals to the series regulator is driven directly from the output through the feedback resistor divider and is comprised of transistors (Q108, 107, 106, 105, 104) and driver transistor (Q101). A silicon controlled rectifier (L), which is driven by magnetic amplifier (SL1) and the components of (A2) is designed to regulate the storage voltage across the series regulator. The circuit is such that regardless of the output load requirement, the power dissipation of the series transistor regulator is maintained within its rating.

3-10. The sequence of corrective action around the controlled rectifier regulator loop is as follows: Resistors (M) and (N) comprise a resistance divider from the collectors of transistors (A) to a point 18 volts above the output common point at (TB1-11). Thus, this divider will sense a change in the voltage drop across the pass section. A portion of this voltage is applied to the base of transistor (Q202). Thereby causing the control current of (SL1) to change in accordance with changes in the voltage across the pass section. The control winding of (SL1) sets the firing points of the gates of (SL1). The output of the gates of (SL1) are fed to (Q201) which acts as a pulse-shaper for the silicon controlled rectifier (L). Thus, a change in the voltage across the pass section triggers the silicon controlled rectifier in such a manner to change the average voltage at (C1) so that the voltage drop across the pass section is maintained constant.

Output voltage control is achieved in the following manner. Suppose the Output Adjust (G) is varied to produce a reduced output voltage. Since the series regulator's response is much faster than the controlled rectifier, a momentary situation develops in which the series regulator voltage increases, i. e., the voltage at C1 holds momentarily while the output voltage is reduced. As described above, when the series regulator voltage increases, the storage regulator amplifier loop causes the controlled rectifier output to restore the original series regulator voltage. In this case, the voltage at C1 drops to compensate for the output voltage reduction. It is thus seen that the controlled rectifier output at C1 tends to "track" the output voltage, and in this manner maintains the series regulator dissipation within fixed limits.

3-11. The sequence of corrective action around the series-regulator feedback loop is as follows: The input to transistor (Q107) is the zero reference level -- in this case, the voltage at the negative terminal of the load. The input to transistor (Q108) is the difference between the voltage across diode (CR111) (the reference voltage) and the voltage on the sensing voltage divider. When the DC load voltage is at the selected value, the voltage at the divider and the voltage across diode (CR111) are equal, though of opposite polarity, and cancel each other out, so that the base of (Q108) is at the same potential as the base of (Q107) and the outputs of the two transistors are balanced. When the load voltage tends to deviate from the selected value in either direction, due to a change in the load current or in input line voltage, this causes the voltage on the sensing divider to differ from the voltage across the reference diode (CR111) and the difference (or "error") voltage unbalances the amplifier stage (Q107)-(Q108). This difference appears in amplified form in the output of this stage, and is further amplified by the subsequent amplifier stages before being applied to the driver transistor (Q101). The output of the driver transistor causes the regulating transistors (A) to increase or decrease its conductivity in accordance with the error signal so that its overall emittercollector voltage drop absorbs the impending variation in load voltage, maintaining an essentially constant value of voltage across the load terminals. Capacitor (C104) assists the amplifier in responding to rapid changes in load voltage by bypassing a portion of the sensing circuit.

The more rapid the change, the greater is the initial transfer of voltage direct to the input of the amplifier, enabling it to anticipate any radical load variation before the excursion becomes significant.

3-12. The sensitivity and speed of response of the corrective feedback circuit is such that the above-described action occurs almost instantaneously, and the actual excursion of the load voltage is held to a very small value. The circuit is a true proportional regulator, and must allow a small but finite "error" to exist between the required and actual regulated voltage, so that this error, however small, can generate the correction signal. By proper circuit design, the error is held to a value which remains within the specified regulation allowance of the power supply.

3-13. When resistor (G) is readjusted to produce a different value of output voltage, the circuit makes a correction similar to that described above. Altering the resistance in the sensing voltage divider unbalances the input stage of the feedback amplifier, which then causes the circuit to produce a new value of voltage such that the drop across resistors (E)-(F) again equals the drop across diode (CR111). Reducing the value of resistor (G) for example, momentarily increases the drop across (E) (F) (assuming a constant value of output voltage). However, this unbalanced condition at the amplifier input causes the DC output voltage to decrease until the drop across (E)-(F) again equals the drop across (CR111) and the circuit stabilizes at this new operating point, establishing a lower value of DC output voltage. See description of corresponding storage regulator action in paragraph 3-10.

3-14. Resistor (E) in the amplifier is provided to permit compensating for manufacturing tolerances in diode (CR111), its load resistor (H), and resistor (F). (This resistor is adjusted at the factory and locked). If any of these components are replaced, check to see that full rated output voltage of the supply is obtainable at full load, with the voltage control at maximum clockwise postion, with line voltage of 105 volts. If not, readjust (F) to provide full voltage under these conditions.

3-15. Overload current limiting action is provided by diodes (CR105) through (CR108) which produce a foward voltage drop of approximately 2.5 volts and effectively clamp the driver transistor (Q101), when the current reaches approximately 125% maximum. Diodes (CR112) through (CR114) provide the same action for the pass transistors. When the base is clamped, the series regulator voltage begins to increase as the load resistance is further reduced. Increased series regulator voltage causes the controlled rectifier storage regulator to react to drive the output voltage down. Transistor (Q109) and diode (CR115) effectively bypass (CR107) and (CR108) as short circuit is approached, thereby accelerating the action of driving the unregulated voltage down. Thus, at a given voltage if the load resistance is gradually reduced, the output voltage will regulated to rated load. As the resistance continues to decrease, the load will increase to about 125% of rated current. At this condition, the output voltage will begin to fall off until short circuit is reached. The combined action of the current limiting circuitry guarantees that under no condition the power supply will be subjected to voltages or currents which will be damaging to the power supply.

SECTION IV

MAINTENANCE

4-1. GENERAL. This section is arranged in the form of a trouble-shooting chart, with symptoms listed approximately in accordance with the frequency of occurrance. Possible causes for each, and their remedies, are listed in logical succession beginning with the most common, to facilitate rapid location and isolation of a defective element.

4-2. SPARE MODULES. Where practical, it is recommended that one or more spare printed circuit boards and regulator assemblies be kept available for use in maintenance. This will reduce down-time to a minimum, and permit easy testing by direct substitution, making it possible to repair a defective module at some convenient time and avoid prolonged interruption of operation.

4-3. MALFUNCTIONS. The various ways in which DC power supply can deviate from normal operation are listed below. Each condition is treated separately in the charts that follow. Component symbol designations refer to the schematic diagram at the rear of the manual. Parts location are indicated in the parts layout photograph also included at the rear.

MALFUNCTION	TYPICAL MAGNITUDE
1. No output voltage at any control setting.	Zero or negative DC output voltage.
2. Low output voltage.	Maximum output voltage obtainable at no load is less than maximum rating.
3. High output voltage.	Minimum output voltage obtainable at no load is more than maximum rating.
4. Failure to regulate.	Output voltage drops 5% or more when load is applied, or varies ±2% or more under a ±10% variation in line voltage.
5. Poor regulation.	Regulation better than above, but not within specification.
6. Excessive ripple.	
A. With good regulation.	RMS ripple exeeds specification, but regulation is within specification.
B. With poor regulation.	RMS ripple exeeds specification, and regulation exeeds specification.

MALFUNCTION	TYPICAL MAGNITUDE
7. Instability.	
A. Random large excursions.	Output voltage "hops" intermittently by 5% or more, with constant load, and constant line voltage.
B. Gradual drift in one direction.	Output voltage changes by 1% or more per minute, after 15-minute warmup.
C. Excessive drift under heavy load only.	Output voltage changes by 1% or more per minute, after a 15-minute warmup, but only after application of a heavy load.
8. Inadequate transient suppression.	Failure to "zero-lag". Upon sudden application of a full-load increase, output voltage dips sufficiently to cause a visible momentary deflection of the voltmeter needle.
9. Oscillation.	
A. High frequency.	Under constant load, output voltage is modulated by sawtooth or sine-wave with frequency of 200 cycles or more per second.
B. Low frequency.	At constant load, output voltage exhibits relaxation modulation at or below 200 cycles per second.

4-4. NO OUTPUT VOLTAGE AT ANY CONTROL SETTING.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Pilot light (DS1) not lit.	1. No line power, or defective input connection.	1. Check power source, lines and connections.
	2. Input fuse (F) blown.	2. Replace fuse. If fuse blows, repeat-edly, do not overfuse.
B, Repeated blowing of fuse (F1).	1. Shorted rectifiers (CR1, CR2) and and/or (L).	1. Replace.

SYMPTOM	POSSIBLE CAUSE	REMEDY
	a. External	a. Check for overload.
C. Unregulated DC across (C) zero or low. Fuse (F1) not blown.	1. Open rectifiers (CR1, CR2) and/ or (L).	1. Replace rectifier or rectifiers.
	2. Primary or secondary power transformer (T1) open.	2. Replace transformer (T1).
D. Unregulated DC present at (C1), but more than 15-25% higher than DC output.	1. Entire, or major part of unregulated DC voltage across (C1) absorbed by regulator transistors (A). Caused by short or excessive leakage between base of driver or regulator transistors (Q101 or A), respectively, and any positive voltage or ground. (For example: If positive output is operated at chassis ground and a wiring short or excessive leakage exists between base of (Q101) and chassis.)	1. Inspect for short. Isolate driver transistor from heat sink and chassis, and operate unit for brief interval. If this restores normal operation, replace driver insulation, and/or driver itself, as necessary. If not cleared, repeat for regulators (A).
	2. Amplifier or sensing circuit defective.	2. Check by momentarily shorting base to collector of (Q101). If DC output is restored amplifier or sensing circuit is at fault. See end of this Section for amplifier check.
	3. Rate sensing capacitor (C104) shorted internally, or by external wiring short.	3. Inspect for short. Disconnect one terminal of capacitor. If DC output is restored, replace capacitor.

SYMPTOM	POSSIBLE CAUSE	REMEDY
	4. Defective driver transistor.	4. Check by momentarily shorting base to collector on driver, transistor at no load. Replace driver transistor.
	5. Ammeter (M1) open.	5. Check by momentarily shorting meter terminals. Replace.
	6. Resistors (P) all open.	6. Replace.

4-5. LOW OUTPUT VOLTAGE RELATIVE TO VOLTAGE ADJUST SETTING.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Unregulated DC present at (C1) in expected magnitude (15% to 30% higher than output voltage at nominal line voltage at no load).	1. Amplifier or sensing circuit defective.	1. Check by momentarily shorting base to collector of (Q101). If this restores DC output, check sensing voltage divider. See end of this Section for amplifier check.
	2. Rate sensing capacitor (C104) has excessive leakage.	2. Disconnect one terminal of capacitor. If this restores DC output, replace capacitor.

4-6. HIGH OUTPUT VOLTAGE.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Output voltage adjust knob has little or no control over DC output.	1. External sensing circuit improperly connected. Internal sensing voltage divider or wiring open.	1. With power off, check continuity of sensing leads, internal sensing circuit from positive output terminals to amplifier input and from negative output terminal to neutral bus of amplifier.

SYMPTOM	POSSIBLE CAUSE	REMEDY
B. Output control effective. Driver base (Q101) negative with respect to negative output terminal.	1. a. Bleeder resistor (R2) open, or regulator transistors (A) I_{CO} drain open Resistor (Q).	1. a. Check by applying full load. If this restores normal operation, check for open resistor or connection.
	b. Defective amplifier.	b. See amplifier check at end of this Section.
	c. Defective amplifier power supply.	c. Check voltage across filter capacitor (C102) (C103), or (C106) as shown on schematic diagram. If correct, check check resistors (C) (D) for open. If incorrect, check the capacitors, (C102, C103), diodes (CR101 thru CR 104) and secondary winding of transformer (T1).
C. Driver base (Q101) positive with respect to negative output terminal.	1. Defective driver and/or pass transistor.	1. Check for shorted transistors.

4-7. FAILURE TO REGULATE.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Load regulation is 5% or more, line regulation 2% or more.	1. a. Defective amplifier.	1. a. See amplifier check at end of this Section.
	b. Defective amplifier power supply.	b. Check voltage values of filter capacitors (C103) (C102).

SYMPTOM	POSSIBLE CAUSE	REMEDY
		b. (continued) If incorrect, check the capacitors, diodes (CR101 thru CR104), and main secondary winding of transformer (T1). Check (C) and (D) for open.
	c. Very low performance transistor in regulator or driver circuit.	c. Check for equal voltages across resistors in series with emitters of power transistors, to detect defective transistor. Check transistors in a transistor test set or by substitution.

4-8. POOR REGULATION.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Load regulation less than 5%, but not within specifications.	1. External sensing circuit incorrectly connected.	1. Check by operating unit with sensing terminals temporarily jumpered to the local output terminals. (Observe correct polarity).
	2. Low gain amplifier.	2. See amplifier check at rear of this Section.
	3. Low beta in driver or power transistor.	3. Check by substitution or in transistor tester. Beta of 20 or more is acceptable.

SYMPTOM	POSSIBLE CAUSE	REMEDY
	4. Oscillating amplifier.	4. Check (C105) for proper value. See amplifier check at the rear of this Section.

4-9. EXCESSIVE RIPPLE.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Output regulation is within specifications.	1. a. Circuit not by-passed to ground.	1. a. One output terminal of the supply should be connected to chassis ground whenever practical, either directly or through a 0.1 mfd. capacitor of appropriate voltage rating.
	b. Filter capacitor (C1, C2) - (C102), or (C103) or (C106) open or of low value.	b. Replace.
	c. Note: Ripple at (C1) should not exeed 5%.	c. Replace.
	d. Rate-sensing capacitor (C104) open or of low value.	d. Replace.
	e. Hum pick-up in external sensing leads.	e. Check by operating unit with sensing terminals temporarily jumpered to local output terminals. Shield or twist external sensing leads.
	f. Low-gain amplifier.	f. See amplifier check at end of this Section.
B. Output regulation poor.	1. a. Low beta in power transistor or driver transistor.	1. a. Check by substitution or in transistor test set. Beta of 20 or more is acceptable.

SYMPTOM	POSSIBLE CAUSE	REMEDY
	b. Low gain amplifier.	b. See amplifier check at the end of this Section.
	c. Defective amplifier power supply.	c. Check diodes (CR101) through (CR104) for shorts or open capacitors (C102), (C103), and (C106) for open, low value, or high leakage. Check diodes (CR110) (CR109) and resistors (C) and (D).

4-10. INSTABILITY.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Random large excursions of output voltage.	1. Intermittent failure of component or intermittent short or open in circuit.	1. Check primary power circuit by temporarily connecting base of driver transistor (A) to negative output terminal. If instability persists, check for intermittent breakdown in rectifiers (CR1 and CR2) or filter capacitors (C1 and C2). Check for intermittent opens or shorts in unregulated DC circuit. Check driver and power transistors in tester, or by substitution. Check for intermittent opens or shorts, or defective component from (C1) to output terminals. Look for intermittent open or short, or intermittently defective component in (1) amplifier, (2) amplifier power supply, or (3) sensing voltage divider and external sensing circuit.

SYMPTOM	POSSIBLE CAUSE	REMEDY
		1. (Continued) Check amplifier connector for poor contact. Check rate-sensing capacitor (C104). Check voltage across (CR109, C R110 and CR111) for stability.
B. Gradual drift in one direction at any load, after 15-minute warmup.	2. a. Defective amplifier.	2. a. See amplifier check at end of this Section.
	b. Drifting zeners.	b. Check (CR109), (CR110) and (CR111). Replace if faulty.
	c. Output adjust potentiometer (G) unstable.	c. Replace.

4-11. INADEQUATE TRANSIENT RESPONSE.

NOTE: This condition should be checked by an oscilloscope at the output terminals of the supply, with the sensing terminals temporarily jumpered to the corresponding output terminals. None of the load current should be permitted to flow through any portion of the oscilloscope leads or the sensing leads.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Regulation and ripple are within specification, and external sensing circuit is properly and firmly connected.	1. a. By-pass capacitor (C2) open, or very low in value.	1. a. Replace.
	b. Filter capacitor (C1) low in value.	b. Replace.
	NOTE: A brief transient during switching is normal. The measurement of transient response may be complicated by inductive transients of 1 to 50 microsecond duration due to lead inductance etc., but since these are	

SYMPTOM	POSSIBLE CAUSE	REMEDY
	NOTE: (continued) easily handled by means of local by-passing, they have no significance in determination of the transient response of the supply.	

4-12. OSCILLATION.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Under constant load, output voltage varies at a cyclic rate (saw-tooth or sine wave) of 200 cycles or more per second.	1. a. Defective diodes (CR109), (CR110) or resistors (C) (D).	1. a. Replace.
	b. By-pass capacitor (C2) is open or of low value.	b. Replace.
	c. Rate sensing capacitor (C104) or its circuit is open.	c. Replace.
	d. Suppressor capacitor (C105) in amplifier is open or of low value.	d. Replace.
B. Under constant load, output voltage varies in "saw-tooth" manner at a frequency of 200 cycles or less.	2. a. Output capacitor (C2) is open.	2. a. Replace.
	b. Rate sensing capacitor (C104) is open, or of low value.	b. Replace.

SYMPTOM	POSSIBLE CAUSE	REMEDY
	c. Excessive capacitance in external load circuit.	c. If load contains capacitance equal to or greater than output capacitor (C2), special precautions are necessary. Check with NJE Corp. engineering department.
	d. Excessive amplifier gain.	d. If the beta (current gain) of one or more amplifier transistors is 150% or more of the manufacturer's bogie value, the increased gain which results (particularly at high ambient temperature) could result in this type of oscillation. Replacement of the transistor is required.

4-13. REGULATION CHECK. Because of the inherently slight regulation exhibited by this power supply, it is impractical to make a regulation check by observing a voltage measurement across the output terminals of the supply as the line or load is varied.

4-14. To accurately check the regulation, it is necessary to use an external source of DC voltage of approximately the same value as the power supply output, connected as shown in Figure 3. This DC bucking voltage can be either an electronic unit, null balance differential voltmeter, or a group of batteries connected in series, furnishing a DC potential larger than the output voltage of the power supply under test. The voltmeter should have a full-scale range of 0 to 5 or 10 volts (5-0-5 with center zero, if available), since it will be used to measure only the difference between two almost equal voltages. The balance adjustment is used to bring the meter needle to approximately midscale before testing, so that the deviation above or below the normal output of the supply under test can be observed.

4-15. The dummy load is selected to draw full load current at the nominal output voltage of the supply. The difference between the voltmeter readings with the switch open and closed (allowing the needle to come tonrest before reading), gives the static load regulation in volts.

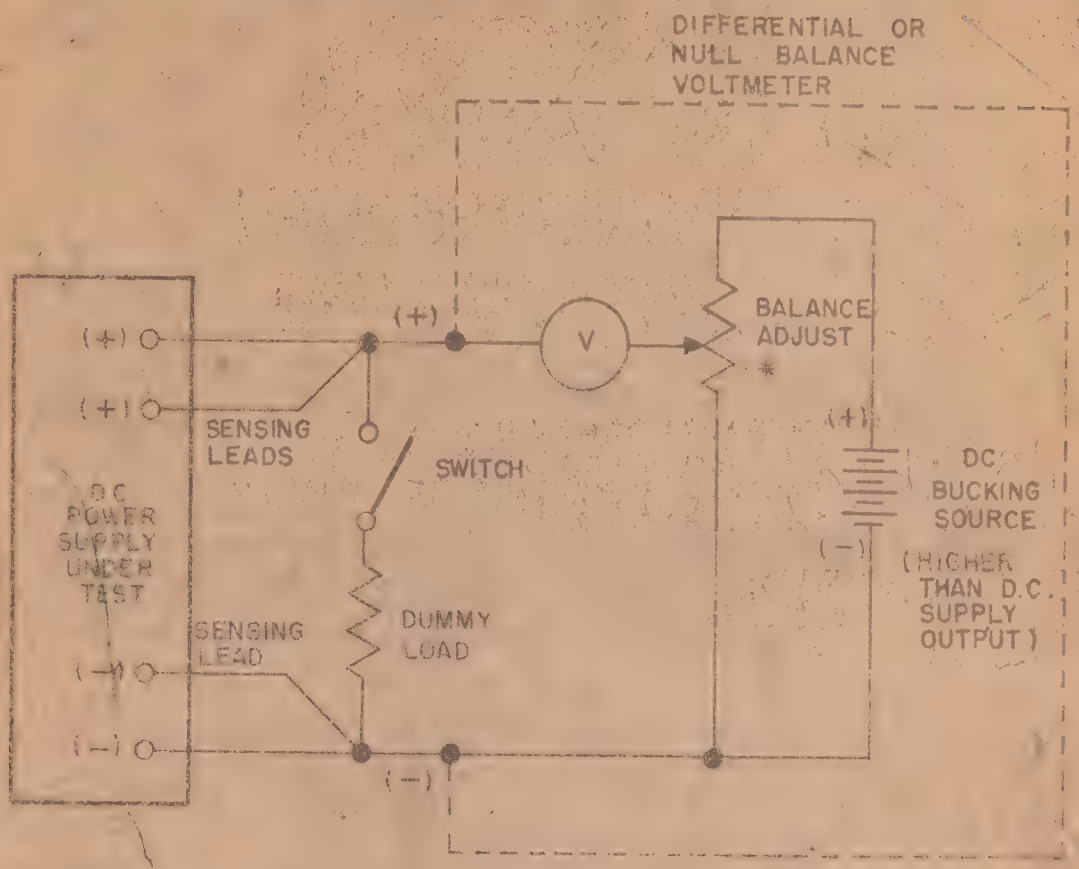
4-16. Dynamic regulation is measured by substituting a calibrated oscilloscope for the voltmeter, and measuring the maximum deflection as a dummy load of appropriate value is switched in and out of the circuit.

4-17. FEEDBACK AMPLIFIER CHECK. There are several methods which can be used in checking the performance and condition of the feedback amplifier.

Except for individually removing the transistors for a check by means of a transistor test set, and making continuity and resistance tests on the circuit and components, all methods require the amplifier to be energized with the proper potentials under the conditions found in the power supply for normal operation. For this reason, it is simplest to test the amplifier in position in the supply, first making certain that its DC power supply (transformer T1), rectifiers (diodes CR101 thru CR104), capacitors (C102 and C103), diodes (CR109 and CR110) and resistors (C) and (D) are functioning properly. This can be quickly ascertained by checking the circuit voltages as indicated on the schematic diagram. Once this is done, the procedures given below can be used to check out the amplifier itself.

a. Voltage Check. The simplest and most rapid direct check of the amplifier is made by connecting a temporary jumper from the base of transistor (Q107) to the base of transistor (Q108), therby balancing the amplifier input stage, and checking for balanced voltages on the two defective stage, and simple analysis will pinpoint the defective connection or component. Verification is then made by testing the component itself or repairing the connection.

b. Signal Tracing Check. Since there is an inherent amount of ripple at the input to the amplifier, this ripple signal can be used as a test signal for observing the amplifier performance with the aid of a test oscilloscope. (Ignore any spikes in the waveform. Use only the basic ripple signal when making amplitude calculations). In the event that the ripple is too small for practical use, a small 60-cycle sine wave voltage of convient amplitude (less than 1/4-volt) can be injected into the amplifier, applying it across the amplifier terminals on printed circuit board for convenience. Measurement of the ripple at the input to the amplifier, and at the output of each successive amplifier stage will provide an effective check of amplifier performance. The ripple amplitude measured across the bases (or input) of the second stage transistors (Q105 and Q106) should be 20 to 40 times the amplitude at the input to the first stage.



* RUN AS LITTLE CURRENT AS POSSIBLE THRU DIVIDER SO THAT BATTERY VOLTAGE DOES NOT DECAY

PRECISE REGULATION CHECK

FIGURE 3

The ripple at the base of the next stage, transistor (Q104) should be 15 to 30 times the ripple at the input to the previous stage. The ripple at the output terminal of the amplifier should be roughly the same as the input to transistor (Q104). Radical departure from this set of conditions will point up a defective component or connection, which can then be isolated by inspection and individual test. Be sure not to over drive the amplifier stages as it will cause misleading results.

c. Stability Check. A detailed check for improper drift and intermittent failure can be made by utilizing a test rig similar to that shown for precise regulation check in Figure 3. The voltage across the zener diode reference source (CR111) is "bucked out", and monitored by a 0 to 1-volt (or smaller scale, if available) high impedance DC voltmeter (null balance voltmeter). Drift or random instability will be readily visible in this test. Output voltages of the successive amplifier stages and regulating diodes (CR109) and (CR110) can then be monitored in the same manner. When checking a given amplifier stage by this method, the output of the previous stage should be shorted, to prevent external voltage variations from reaching the stage under test. When installing a new transistor in place of one shown to be defective, the stability check should be repeated, to make certain that the trouble has been eliminated.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: CR 18-30 Proj. App.

Unit: Main Ass'y Std. App.

Ref. Des.	Description	NJE Part No.	Qty	**Rec. Spare	* Rec. Vendor
	SCHEMATIC	205768	*		23
M1	Ammeter	1M3-30-ADC	1	1	16
M2	Voltmeter	1M3-20VDC	1	1	16
R3	Res, Var, WW 2600, 5W	2RVW-5-2600	1	1	30
R4	Res, Shunt	1RMS-50-30	1	1	16
R5	Not Used				
R6	Not Used				

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: ECR 18-30 Proj. App.

Unit: Main Ass'y Std. App. Sheet 1 of 12

Ref. Des.	Description	NJE Part No.	Qty	**Rec. Spare	*Rec. Vendor
	SCHEMATIC	205786	x		23
J1	Jack, Tip, red	2JR	1	1	19
J2	Jack, Tip, black	2JB	1	1	19
R3	Not Used				
R4	Not Used				
R5	Res, Var, WW 2500, 2W	1RVW-2-2500-N	1	1	9
R6	Res, Var, WW 150, 2W	1RVW-2-150-N	1	1	9

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: CRV-18-30 Proj. App.

Unit: Main Ass'y Std. App.

Ref. Des.	Description	NJE Part No.	Qty	** Rec. Spare	* Rec. Vendor
	SCHEMATIC	205887	x		23
C9	Cap, Fixed, Tant 30MF, 100V	1CT-100-30	1	1	17
C10	Cap, Fixed, Paper 0.5MV, 200V	1CP-200-0.5	1	1	17
CR4	Semicond. device diode	CER 530	2	1	29
CR5	Same As CR4				
R3	Res, Var, WW 2600, 5W	2RVW-5-2600	1	1	30
R4	Res, Shunt	1RMS-50-30	1	1	16
R5	Not Used				
R6	Not Used				
R8	Res, Var, Comp Special	101040	1	1	23
R9	Res, Fixed, WW 0.1, 50W	1RFW-50-0.1	2	1	33
R10	Same As R9				
S2	Switch part of variable resistor assembly R8				
M1	Ammeter	1M3-30ADC	1	1	16
M2	Voltmeter	1M3-20VDC	1	1	16

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: ECRV 18-30 Proj. App.

Unit: Main Ass'y Std. App.

Ref. Des.	Description	NJE Part No.	Qty	** Rec. Spare	*Rec. Vendor
	SCHEMATIC	205956	x		23
C9	Cap, Fixed, Tant 30MF, 100V	1CT-100-30	1	1	17
C10	Cap, Fixed, Paper 0.5MF, 200V	1CP-200-0.5	1	1	17
CR4	Semicond. device diode	CER 530	2	1	29
CR5	Same As CR4				
J1	Jack, Tip, red	2JR	1	1	19
J2	Jack, Tip, black	2JB	1	1	19
R3	Not Used				
R4	Not Used				
R5	Res, Var, WW 2500, 2W	1RVW-2-2500-N	1	1	9
R6	Res, Var, WW 150, 2W	1RVW-2-150-N	1	1	9
R8	Res, Var, Comp Special	101040	1	1	23
R9	Res, Fixed, WW 0.1, 50W	1RFW-50-0.1	2	1	33
R10	Same As R9				
S2	Switch part of variable resistor assembly R8				

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: 18-30 Proj. App.

Unit: Main Ass'y Std. App. Sheet 2 of 12

Ref. Des.	Description	NJE Part No.	Qty	**Rec. Spare	* Rec. Vendor
A1	Printed Ckt Ass'y 67 PC-1	402262	1	1	23
A2	Ckt. Card Ass'y 65 PC-2	301883	1	1	23
A3	Overload Adapter	205766	1	1	23
B1	Blower	3B	1	1	28
C1	Cap, Fixed, Elect 16, 500MF, 30V	2CE-30-16.5K	5	1	17
C2	Cap, Fixed, Elect 6700MF, 50V	2CE-50-6700	2	1	17
C3	Not Used				
C4	Not Used				
C5	Cap, Fixed, Paper 0.01MF, 400V	1CP-300-0.01	1	1	17
C6	Not Used				
C7	Not Used				
C8	Not Used				

* Recommended vendors are listed at the end with serial cross references.

** Recomended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: 18-30 Proj. App.

Unit: Main Ass'y Std. App.

Ref. Des.	Description	NJE Part No.	Qty	**Rec. Spare	*Rec. Vendor
CR1	Semicond. device diode	1N2156	2	1	16
CR2	Same As CR1				
CR3	Semicond. device diode	C50AX165	1	1	16
DS1	Lamp, glow	1DS-115-MB-N	1	1	13
F1	Fuse, Cartridge	1FSB-32-15	1	5	21
Q1	Semicond. device transistor	2N1146	6	1	10
Q2	Same As Q1				
Q3	Same As Q1				
Q4	Same As Q1				
Q5	Same As Q1				
Q6	Same As Q1				

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH N. J.

Spare Parts List

Model: 18-30 Proj. App.

Unit: Main Ass'y Std. App.

Ref. Des.	Description	NJE Part No.	Qty	** Rec. Spare	*Rec. Vendor
R1	Res, Fixed, WW 75, 25W	1RFW-25-75	1	1	33
R2	Res, Fixed, WW 10, 50W	1RFW-50-10	1	1	33
R7	Res, Var, WW 1000, 2W	1RVW-2-1000-N	1	1	9
S1	Switch Toggle	1SW-SPST	1	1	19
SL1	Mag Amp	204526	1	1	23
T1	Transformer	204369	1	1	23
TB1	Terminal Board	1TB-10-12	1	-	8
XDS1	Lampholder	1XDS-R	1	-	13
XF1	Fuseholder	1XF	1	-	6
XSL1	Socket	4XV	1	-	8

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: 18-30 Proj. App.

Unit: Ckt. Card Ass'y (67PC-1) Std. App.

Ref. Des.	Description	NJE Part No.	Qty	** Rec. Spare	*Rec. Vendor
C101	Cap, Fixed, Tant 25MF 50V	1CT-50-25	1	1	17
C102	Cap, Fixed, elect 300MF, 150V	5CE-150-300	3	1	17
C103	Same As C102				
C104	Cap, Fixed, Tant 11MF, 100V	2CT-100-11	1	1	17
C105	Cap, Fixed, Paper 0.05MF, 200	1CP-200-0.05	1	1	17
C106	Same As C102				
CR101	Semicond. device diode	CER 530	6	1	29
CR102	Same As CR101				
CR103	Same As CR101				
CR104	Same As CR101				
CR105	Not Used				
CR106	Not Used				
CR107	Not Used				
CR108	Not Used				

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: 18-30 Proj. App.

Unit: Ckt. Card Ass'y (67PC-1) Std. App.

Ref. Des.	Description	NJE Part No.	Qty	**Rec. Spare	*Rec. Vendor
CR109	Semicond. device diode	1N1357R	2	1	34
CR110	Same As CR109				
CR111	Semicond. device diode	1N429	1	1	24
CR112	Same As CR101				
CR113	Same As CR101				
CR114	Semicond. device diode	1N91	1	1	16
F101	Fuse	3FFB-125-1/32	1	5	21
Q101	Semicond. device transistor	2N2067	1	1	10
Q102	Not Used				
Q103	Not Used				
Q104	Semicond. device transistor	2N241A	1	1	16
Q105	Semicond. device transistor	2N445A	2	1	18
Q106	Same As Q105				
Q107	Semicond. device transistor	2N331	2	1	18
Q108	Same As Q107				

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: 18-30 Proj. App.

Unit: Ckt. card Ass'y (67 PC-1) Std. App.

Ref. Des.	Description	NJE Part No.	Qty	**Rec. Spare	* Rec. Vendor
R101	Res, Fixed, WW 0.2, 5W	2RFW-5-0.2	6	1	33
R102	Same As R101				
R103	Same As R101				
R104	Same As R101				
R105	Same As R101				
R106	Same As R101				
R107	Res, Adj. WW 750, 10W	1RAW-10-750	1	1	33
R108	Res, Adj, WW 1000, 10W	1RAW-10-1000	1	1	33
R109	Res, Fixed, Comp 22, 1/2W	1RFC-1/2-22	1	1	1
R110	Res, Fixed, WW 3000, 5W	2RFW-5-3000	2	1	31
R111	Res, Fixed, WW 1000, 10W	2RFW-10-1000	2	1	33
R112	Not Used				
R113	Same As R111				
R114	Res, Fixed, Comp 1000, 1/2W	1RFC-1/2-1000	1	1	1
R115	Res, Fixed, Comp 10K, 1/2W	1RFC-1/2-10K	1	1	1

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N.J.

Spare Parts List

Model: 18-30 Proj. App.

Unit: Ckt. Card Ass'y (67 PC-1) Std. App.

Ref. Des.	Description	NJE Part No.	Qty	**Rec. spare	* Rec. Vendor
R116	Res, Fixed, Comp 820, 1/2W	1RFC-1/2-820	1	1	1
R117	Res, Fixed, WW 15K, 1/2W	1RFC-1/2-15K	1	1	1
R118	Res, Fixed, Comp 3900, 1/2W	1RFC-1/2-3900	1	1	1
R119	Res, Fixed, WW 10K, 3W	2RFW-3-10K	3	1	33
R120	Same As R119				
R121	Same As R119				
R122	Res, Fixed, WW 560, 3W	2RFW-3-560	2	1	33
R123	Res, Var., WW 500, 1/2W	3RVW-1/2-500	1	1	12
R124	Same As R122				
R125	Not Used				
R126	Res, Fixed, Comp 5.6, 1W	1RFC-1-5.6	2	1	1
R127	Same As R126				

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: 18-30

Unit: Ckt. Card Ass'y (67 PC-1

Proj. App.

Std. App.

Ref. Des.	Description	NJE Part No.	Qty	**Rec. Spare	*Rec. Vendor
XQ104	Socket, transistors	1XQ-MC	5	-	14
XQ105	Same As XQ104				
XQ106	Same As XQ104				
XQ107	Same As XQ104				
XQ108	Same As XQ104				

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: 18-30 Proj. App.

Unit: Ckt. Card Ass'y (65 PC-2) Std. App.

Ref. Des.	Description	NJE Part No.	Qty	**Rec. Spare	* Rec. Vendor
C201	Not Used				
C202	Cap, Fixed, Elect 100MF, 15V	3CE-15-100	2	1	17
C203	Same As C202				
C204	Not Used				
CR201	Semicond device diode	CER 530	4	1	29
CR202	Same As CR201				
CR203	Same As CR201				
CR204	Same As CR201				
CR205	Semicond. device diode	1N1357R	1	1	34

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP. , KENILWORTH, N. J.

Spare Parts List

Model: 18-30

Unit: Ckt. Card Ass'y (65 PC-2)

Proj. App.

Std. App.

Ref. Des.	Description	NJE Part No.	Qty	** Rec. Spare	* Rec. Vendor
Q201	Semicond. device transistor	2N445A	1	1	18
Q202	Semicond. device transistor	2N241A	1	1	16
R201	Res, Fixed, Comp 22, 1/2W	1RFC-1/2-22	1	1	1
R202	Res, Fixed, Comp 120, 2W	1RFC-2-120	1	1	1
R203	Res, Fixed, Comp 470, 2W	1RFC-2-470	1	1	1
R204	Res, Fixed, Comp 1000, 2W	1RFC-2-1000	1	1	1
R205	Res, Fixed, Comp 270, 1/2W	1RFC-1/2-270	1	1	1
R206	Res, Fixed, WW 1500, 10W	2RFW-10-1500	1	1	33
XQ201	Socket	1XQ-MC	2	-	14
XQ202	Same As XQ201				

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

NJE CORP., KENILWORTH, N. J.

Spare Parts List

Model: 18-30 Proj. App.

Unit: Overload Adapter Std. App.

Ref. Des.	Description	NJE Part No.	Qty	**Rec. Spare	*REc. Vendor
C301	Cap, Fixed, Ceramic 0.1 MF, 75V	1CC-75-0.1	2	1	7
C302	Same As C301				
CR301	Semicond. device diode	CER 530	1	1	29
CR302	Semicond. device diode	1N91	1	1	16
Q301	Semicond. device transistor	2N241A	1	1	16
Q302	Semicond. device transistor	2N445A	1	1	18
R301	Res, Fixed, Comp 22K, 1/2W	1RFC-1/2-22K	1	1	1
R302	Res, Fixed, Comp 1500, 1/2W	1RFC-1/2-1500	1	1	1
R303	Not Used				
R304	Res, Fixed, Comp 4700, 1/2W	1RFC-1/2-4700	1	1	1
R305	Res, Var, WW 7500, 2W	1RVW-2-7500-SL	1	1	9
XQ301	Sockets	1XQ-MC	2	-	14
XQ302	Same As XQ301				

* Recommended vendors are listed at the end with serial cross references.

** Recommended spares are for one unit for one year service.

List of Code Numbers used in

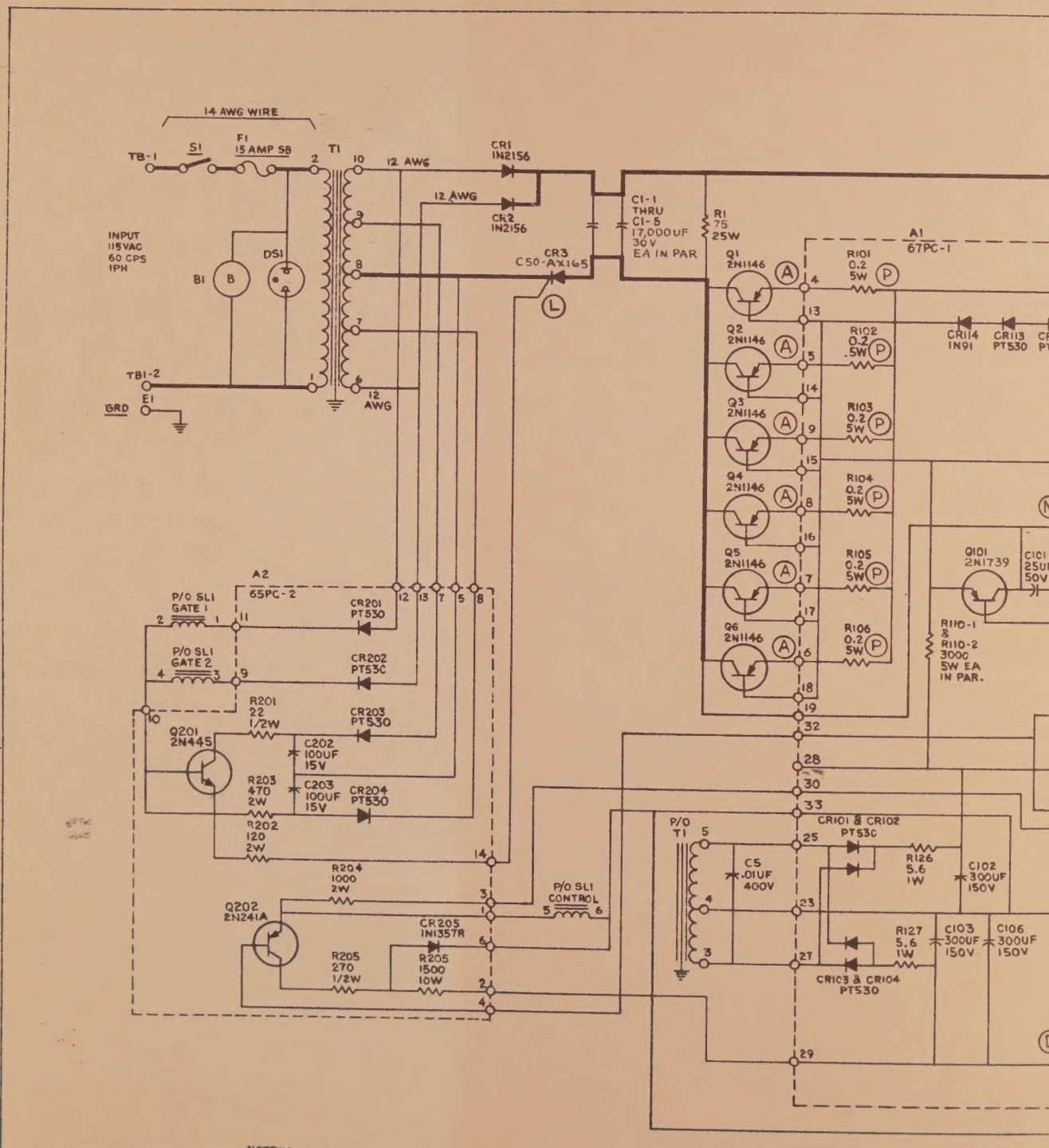
Spare Parts List

To Indicate Manufacturer

Code Number	Manufacturer	Location
1	Allen-Bradley Co.	Milwaukee, Wisconsin
2	Astron	East Newark, N. J.
3	Barber Colman Co.	Rockford, Illinois
4	Helipot (Div. of Beckman Inst.)	Fullerton, Calif.
5	Bourns Inc.	Riverside, Calif.
6	Bussmann (Div. of McGraw-Edison)	St. Louis, Mo.
7	Centralab Elec. (Div. Globe-Union)	Milwaukee, Wisc.
8	Cinch Mfg. Co. (H. B. Jones Div.)	Chicago, Ill.
9	Clarostat Mfg. Co.	Dover, New Hampshire
10	Clevite Transistor	Waltham, Mass.
11	Columbus Electronics	Yonkers, N. Y.
12	Dale Electronics (Sub. of Hathaway Ins. Inc.)	Columbus, Nebraska
13	Dialight Corp.	Brooklyn, N. Y.
14	Elco Manufacturing	Philadelphia, Pa.
15	Fansteel	No. Chicago, Ill.
16	General Electric	Syracuse, N. Y.
17	General Instrument	Newark, N. J.
18	General Transistor	Los Angeles, Calif
19	Herman H. Smith	Brooklyn 10, N. Y.
20	Hoffman	El Monte, Calif.
21	Little Fuse Inc.	Des Plaines, Ill.
22	Motorola	Phoenix, Ariz.
23	NJE Corporation	20 Boright Avenue, Kenilworth, N. J.
24	North Amer. Elec. (Affiliate of I. R. C.)	West Lynn, Mass.

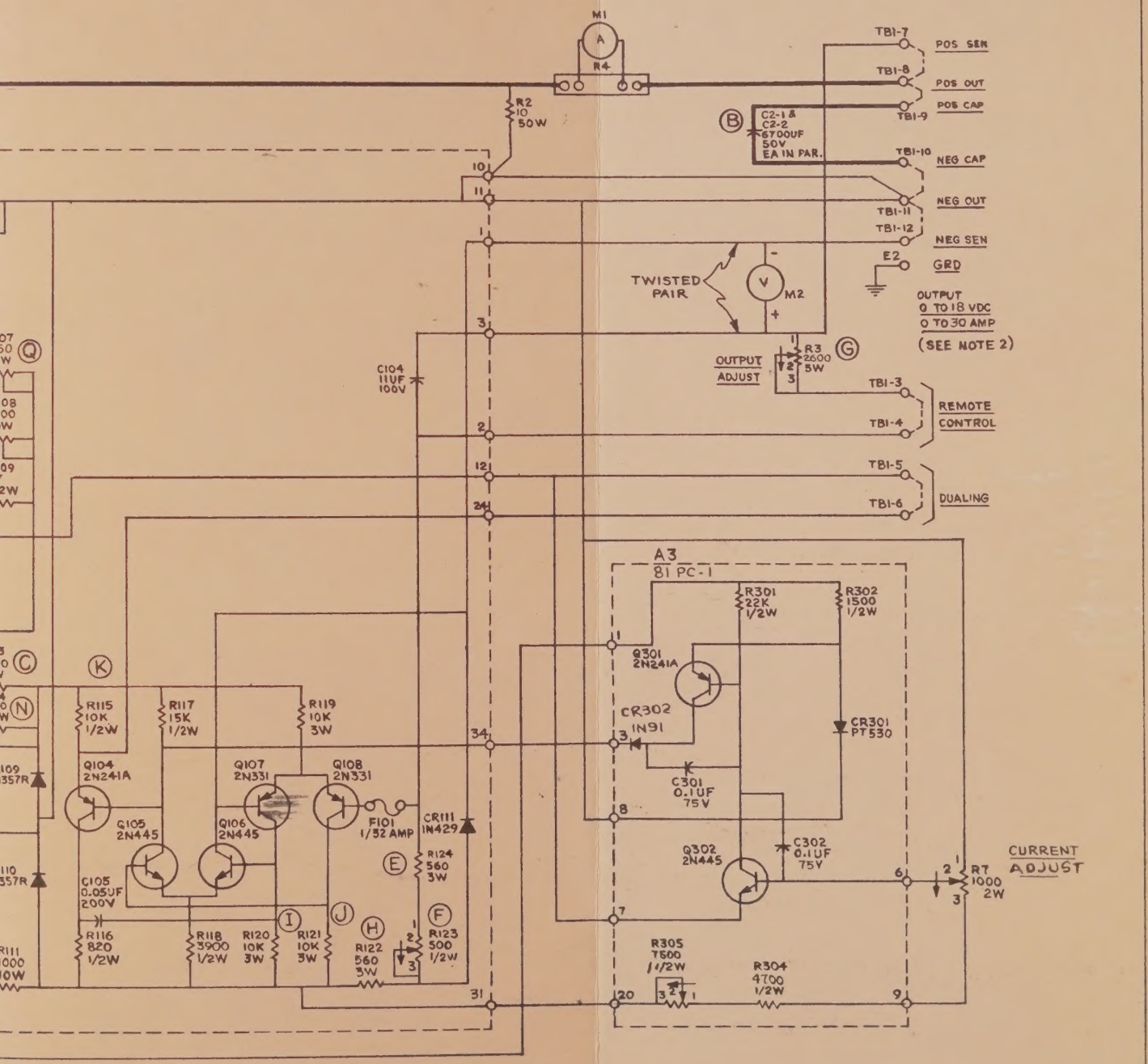
(List of Code Numbers used in Spare Parts List To Indicate Manufacturer cont'd)

Code Number	Manufacturer	Location
25	Ohmite	Skokie, Ill.
26	Philco	Lansdale, Pa.
27	Pyramid Elec. Co. (Div. of Gen. Inst.)	Darlington, S. C.
28	Rotron	Woodstock, N. Y.
29	Solitron	Norwood, N. J.
30	Spectrol	San Gabriel, Calif.
31	Sprague	North Adams, Mass.
32	Superior Electric Co.	Bristol, Conn.
33	Tru-Ohm (Model Eng.)	Chicago, Ill.
34	U. S. Semcor	Phoenix, Arizona
35	Westinghouse	Youngwood, Pa.
36	Standard Electric Co.	Dayton, Ohio
37	Stancor Electronics, Inc.	Chicago, Ill.
38	Jettron Products	Hanover, N. J.
39	Dickson Electronics Corp.	Scottsdale, Ariz.
40	Aerovox Corp.	New Bedford, Mass.
41	Radio Switch	Marlboro, N. J.
42	Radio Corp. of Amer. (Elec. Tube. Div.)	Harrison, N. J.
43	Cornell Dublier (Div. of Fed. Pacific Elec.)	Newark, N. J.
44	Chicago Cond. Corp.	Chicago, Ill.
45	Arco Electronics	Great Neck, N. Y.
46	International Resistance Co.	Philadelphia, Pa.
47	Amperex Electronics Corp.	Hicksville, N. Y.
48	Resistor Products Co.	Harrisburg, Pa.
49	Syntron Co.	Homer City, Pa.
50	Amphenol Connector (Div. of Amphenol-Borg)	Chicago, Ill.
51	Continental-Wirt.	Philadelphia, Pa.
52	Royal Electric Corp.	Pawtucket, R. I.



MODEL
CR18-30B
SCHEMATIC
DIAGRAM

NOTES:
1. — INDICATES NO.10 AWG WIRE
— INDICATES NO.20 AWG WIRE UNLESS OTHERWISE SPECIFIED
2. 1 AMP PRELOAD NEEDED BETWEEN 0-3VDC



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CR18-30B
SCHEMATIC DIAGRAM

MANUFACTURERS REPRESENTATIVES

Albuquerque, New Mex.

Barnhill Associates
319A Wyoming N.E., Albuquerque, New Mex.
265-7766

Boston, Mass.

Burlingame Associates, Ltd.
7 Wellington Street, Waltham, Mass.
TWinbrook 4-1955

Chicago, Ill.

Ridgway Associates
6100 W. North Ave., Chicago 39, Ill.
TUxedo 9-5715

Cleveland, Ohio

Ridgway Associates
5915 Schaaf Rd., Cleveland 31, Ohio
LAfayette 4-1421

Dallas, Texas

Carey-Wolf Co.
P.O. Box 12425, Ft. Worth, Tex.
TA 3-5383

Dayton, Ohio

Ridgway Associates
3898 Linden Ave., Dayton 29, Ohio
CLearwater 2-5604

Denver, Colo.

Barnhill Associates
1170 South Sheridan Blvd., Denver, Colorado
WEst 5-4645

Detroit, Mich.

Ridgway Associates
3384 Twelve Mile Rd., Berkley, Michigan
Lincoln 6-3312

Ft. Worth, Texas

Carey-Wolf Co.
P.O. Box 12425, Ft. Worth, Tex.
PE 8-1702

Houston, Texas

Carey-Wolf Co.
P.O. Box 14426, Houston, Tex.

Indianapolis, Ind.

Ridgway Associates
1224 N. Capitol Ave., Indianapolis 2, Indiana
MElrose 5-2401

Kansas City, Mo.

Lee Mark Associates
4021 W. 86th St., Prairie Village, Kansas
Niagara 2-3313

Los Angeles, Calif.

G. S. Marshall Company
2065 Huntington Drive, San Marino, Calif.
MUrray 1-3292

Montreal, Canada

Radienics, Ltd.
8230 Mayrand St., Montreal, Canada
REgent 9-5517

New York City Area

Burlingame Associates, Ltd.
510 South Fulton Ave., Mt. Vernon, N. Y.
MOunt Vernon 4-7530

Ontario, Canada

Radienics, Ltd.
4938 Yonge St., Willowdale, Ontario
222-3261

Philadelphia, Pa.

Burlingame Associates, Ltd.
222 Long Lane, Upper Darby, Pa.
JAckson 8-6080

Phoenix, Arizona

G. S. Marshall Company
30 Pima Plaza, Scottsdale, Ariz.
WHitney 6-5521

St. Louis, Mo.

Lee Mark Associates
2001 Big Bend Blvd., St. Louis 17, Mo.
Mission 7-1470

Salt Lake City, Utah

Barnhill Associates
300 So. Main, Centerville, Utah
AXtel 5-6521

San Diego, Calif.

G. S. Marshall Company
4410 Kearny Mesa Rd., San Diego, Calif.
BR 8-6350

San Francisco, Calif.

G. S. Marshall Company
801 Woodside Rd., Redwood City, Calif.
EMerson 6-8214

Seattle, Washington

Burt C. Porter Company
1209 Poplar Place, Seattle 44, Washington
EAst 3-8330

Syracuse, N. Y.

Burlingame Associates, Ltd.
514 University Bldg., Syracuse, N. Y.
GRanite 4-7409

Washington, D.C.

Burlingame Associates, Ltd.
8218 Wisconsin Ave., N.W., Washington 14, D.C.
OLiver 4-6400

Winston-Salem, N.C.

M. J. McDonald Co.
Whippoorwill Drive, Rt. 1, Pfafftown, N. C.
WAbash 4-2182

OUR WARRANTY: N J E Corp. warrants each power supply manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replacing any defective parts thereof, except tubes, semi-conductors and fuses. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and which upon our examination is disclosed to our satisfaction to be defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started. Written permission must be obtained from the factory, before a supply may be returned for examination.

NJE CORPORATION
Electronic Development & Manufacturing
Kenilworth, New Jersey • BRidge 2-6000
TELEFAX: FFP • TWX: CRANFORD 51